Chemical & Engineering NEWS

Nuclear regulator Nunzio Palladino streamlines rules to improve safety
Page 14

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Adhesives change old-time glue into growing chemical specialties

Page 8

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Chemical & Engineering NEWS

Cover: Adhesives development laboratory at H. B. Fuller, St. Paul, Minn.

2 Letters

Concentrates
7 Business
11 Government
22 Science/Technology

The Departments
34 ACS Comment
41 Meetings
42 Awards
52 Newscripts

News of the Week

- ***Steep earnings slide continues*** *for U.S. chemical industry; third-quarter results show little sign of recovery.* ***Page 4***
- ***Environmental concerns*** *vie with economic issues in the political arena, especially with elections looming.* ***Page 5***
- ***High-technology fields*** *attractive to states hoping to encourage scientific and industrial development.* ***Page 5***
- ***First three-dimensional model of ATP synthetase*** *constructed at Johns Hopkins school of medicine.* ***Page 6***
- ***Biotechnology firm encounters financial difficulties*** *in its bid to be a leader in agricultural technology.* ***Page 6***

Business

- ***Specialty adhesives are faring well*** *despite current recession, with several producers reporting good third quarters.* ***Page 8***

International

- ***Japanese chemical industry*** *is still struggling with depressed markets, excess capacity, high costs, poor profits.* ***Page 10***

Government

- ***Commission on precollege education*** *in math and science is examining the shortage of high-quality teachers, inadequate curricula, and problem areas.* ***Page 12***

Public Policy

- ***Nuclear Regulatory Commission chairman Nunzio Palladino*** *outlines in a C&EN interview his ongoing efforts to improve nuclear safety.* ***Page 14***

Science

- ***Analytical chemists and regulators*** *meet to discuss ways to strengthen scientific base for regulation and improve interaction between the two groups.* ***Page 25***

Technology

- ***Handling of recent train derailment*** *that spilled hazardous chemicals is praised; lack of injuries ascribed to preparedness, train's safety features.* ***Page 28***
- ***New background correction system*** *for atomic absorption spectrometry, using hollow cathode lamp, eliminates many spectral interferences.* ***Page 30***

Books

- ***"Radwaste: A Reporter's Investigation of a Growing Nuclear Menace"*** *by Fred Shapiro presents a comprehensive overview of both the problems and progress.* ***Page 32***

ACS News

- ***Official reports from the Kansas City meeting*** *include major actions taken by council and board committees.* ***Page 35***

FEW COMPANIES ESCAPE EARNINGS PLUNGE

There is little joy in the U.S. chemical industry at the end of the third quarter. With 30 major U.S. chemical companies reporting so far, it's safe to say the third quarter simply continued the industry's steep earnings slide, which began in fourth-quarter 1981.

Of these 30 companies, 27 have posted declines in earnings, two with red ink. Just as serious, sales for 23 of them also dropped, an unusual event in the chemical industry. Sales decreases ranged from 1 to 20% or more from the same period last year.

Since chemical industry sales this year already were down almost 7% through the first six months from last year, it's certain that sales will be down for the full year. In recent decades, this has happened only once before, in 1975, for basic chemical companies.

Sales and earnings declines for chemical companies run across the product board. Plastics operations still are down, although at a few companies—notably Monsanto and Allied—plastics performed better in the third quarter this year than a year earlier. Fibers also are off from a year ago; fertilizers are not performing well; and even specialty chemicals such as adhesives and synthetic lubricants now are getting hit. (One of the few exceptions is specialty adhesives; see page 8.)

In fact, many of the harder hit companies in the third quarter were smaller, more specialty-oriented firms. For instance, earnings at adhesives maker H. B. Fuller dropped 34% from last year's third quarter to $2.5 million. Sales were off 5% to $79.6 million. Another adhesives

Sales, earnings for almost all companies dropped in third quarter

	Third-quarter 1982						Nine-months 1982					
			Change from 1981		Profit margin[b]				Change from 1981		Profit margin[b]	
	Sales	Earnings[a]	Sales	Earnings	1982	1981	Sales	Earnings[b]	Sales	Earnings	1982	1981
Air Products[c]	$ 415.6	$ 26.9	3%	−7%	6.5%	7.1%	$1195.4	$ 80.4	−1%	−14%	6.7%	7.8%
Allied[d]	1514.0	881.0	−2	1	5.4	5.2	4723.0	226.0	—	−10	4.8	5.3
American Cyanamid[e]	861.2	27.1	−8	−48	3.1	5.6	2607.8	90.3	−4	−39	3.5	5.5
Chemed[f]	64.2	3.9	−1	−19	6.1	7.4	188.9	13.1	1	−15	6.9	8.2
Dow Chemical[g]	2548.0	35.0	−13	−73	1.4	4.4	8057.0	329.0	−9	−34	4.1	5.6
Ethyl	410.7	23.0	−8	8	5.6	4.7	1231.0	68.0	−7	1	5.5	5.0
FMC	863.0	29.0	2	−29	3.4	4.8	2612.4	106.7	5	−13	4.1	4.9
First Mississippi	49.2	5.0	14	−27	10.2	15.8	163.0	9.7	−11	−25	6.0	7.1
H. B. Fuller	79.6	2.5	−5	−34	3.1	4.6	235.2	6.6	−5	−36	2.8	4.2
GAF[h]	179.2	8.8	1	def	4.9	def	482.1	−1.3	−9	def	def	0.4
B. F. Goodrich[i]	795.4	−0.1	−3	def	def	1.8	2300.0	−3.5	−4	def	def	1.9
W. R. Grace[j]	1441.9	44.4	−9	−31	3.1	4.0	4535.3	200.4	−5	−19	4.4	5.2
Hercules[k]	602.0	25.6	−13	−29	4.3	5.2	1690.0	69.8	−9	−42	3.7	5.8
Philip A. Hunt	29.4	1.0	7	−41	3.4	6.2	89.2	5.0	9	9	5.6	5.6
International Minerals	356.5	24.4	−12	−32	6.8	8.9	1176.4	52.6	−19	−55	4.5	8.0
Loctite	53.1	3.6	−3	−29	6.8	9.4	162.3	10.1	−3	6	6.2	5.7
Lubrizol	199.0	11.9	−10	−50	6.0	10.8	615.7	41.1	−9	−45	6.7	11.0
Monsanto[l]	1504.5	71.0	−8	27	4.7	3.4	4859.6	304.7	−10	−6	6.3	6.0
Nalco Chemical	160.1	17.6	−5	−17	11.0	12.6	485.0	49.4	−1	−18	10.2	12.2
National Distillers	448.4	15.5	−7	−49	3.5	6.3	1377.7	61.9	−9	−38	4.5	6.6
Olin	433.9	11.2	−11	−37	2.6	3.6	1407.8	56.6	−10	−28	4.0	5.1
PPG Industries	840.0	43.7	−1	−16	5.2	6.2	2470.0	113.5	−3	−34	4.6	6.7
Pennwalt	232.4	7.3	−10	−46	3.1	5.3	732.8	24.5	−9	−38	3.3	4.9
Reichhold Chemicals	197.4	1.1	−20	−71	0.6	1.6	630.2	8.2	−15	−47	1.3	1.8
Rohm & Haas[m]	441.3	17.2	−1	−20	3.9	4.8	1444.6	61.2	−2	−26	4.2	5.6
Stauffer Chemical	283.6	14.1	−17	−1	5.0	4.2	1219.5	113.4	−10	−10	9.3	9.3
Union Carbide[n]	2164.1	60.5	−11	−61	2.8	6.4	6775.6	269.5	−13	−47	4.0	6.5
Williams Cos.[o]	380.6	−0.3	−21	def	def	2.9	1332.4	25.0	−14	−72	2.2	6.7
Witco Chemical[p]	331.8	8.6	2	−10	2.6	2.9	1001.7	21.5	2	−22	2.1	2.8

a After-tax earnings from operations excluding extraordinary and nonrecurring items. b Earnings as a percentage of sales. c Excludes $2.8 million extraordinary gain in third-quarter 1982 and $6.7 million nonrecurring charge for nine-months 1982. d Excludes $38 million gain in third-quarter 1981. e Excludes $2.9 million nonrecurring gain in nine-months 1982. f Excludes $5.3 million nonrecurring gain in third-quarter 1981. g Excludes $57 million extraordinary gain in nine-months 1982. h Third-quarter 1982 excludes $7.0 million nonrecurring gain. i Excludes nonrecurring gain of $8.5 million in third-quarter 1981, $4.4 million in nine-months 1982, and $30.8 million in nine-months 1981. j Excludes $33.7 million nonrecurring gain in third-quarter and nine-months 1981 and $65.1 million nonrecurring gain in nine-months 1982. k Excludes $6.2 million nonrecurring gain in third-quarter 1982. l Excludes $67.7 million nonrecurring gain in third-quarter 1981. m Excludes $9.0 million nonrecurring charge in nine-months 1981. n Excludes $10 million nonrecurring gain in third-quarter 1982; third-quarter and nine-months 1981 figures are on a pro forma basis. o Excludes $3.7 million nonrecurring gain in nine-months 1982. p Excludes $1.0 million charge in third-quarter 1982 and $0.6 million gain in nine-months 1982.

manufacturer, Loctite, posted an earnings drop of 29% to $3.6 million and a sales drop of 3% to $53.1 million.

Lubrizol, another specialties company with a long history of stellar earnings performances, saw profits decrease to $11.9 million in the third quarter, 50% less than in the third quarter last year. Sales dropped 10% to $199 million. According to Lubrizol chairman Lester E. Coleman, earnings and sales declined because of lower product shipments and selling prices.

One of the biggest third-quarter earnings drops reported thus far is Reichhold Chemicals', whose profits fell 71% from last year's quarter to $1.1 million. The company's sales dropped 20% to a little more than $197 million.

Not all of the big declines were at the smaller firms, however. For instance, Union Carbide's third-quarter earnings dropped 61% from a year before to $60.5 million, and its sales dropped 11% to $2.16 billion.

W. R. Grace's third-quarter earnings fell 31% to $44.4 million as sales sagged 9% to $1.44 billion. Grace's chairman and chief executive officer, J. Peter Grace, says, "Looking ahead, the economic signals are mixed, making it difficult to formulate a conclusion as to when a sustainable, non-inflationary upturn may commence."

At Dow Chemical, president Paul F. Oreffice has some hope for the future but not about the current business scene. "Economic conditions continue to hamper our business recovery on nearly a global scale. The grim economic facts of life persist, and no meaningful signs of recovery are apparent. ... Economic conditions are ripe for a business improvement, considering the declining trend of inflation and interest rates. However, we need a shift in consumer confidence to spur spending. I don't believe this change will occur overnight, and any economic recovery will be gradual." Dow had one of the worst third-quarter performances with a 73% earnings drop.

Other leading chemical executives are just as noncommittal, and for good reason. For although financial markets have improved notably in the past half year, manufacturing industries such as chemicals have yet to follow suit. A few chemical areas such as thermoplastics have turned up slightly since last winter, but for most of the industry, there's no sign yet of recovery. And until recovery begins, earnings will continue downhill. □

Environmental issues color election politics

Economic issues are highlighting these off-year elections, but environmental concerns are shading some of them. The recent Sierra Club report faulting the Environmental Protection Agency's custodianship of hazardous dump-site cleanup under Superfund and EPA's response to the charge is a case in point.

Last week the Sierra Club charged EPA with lagging 60% behind schedule in implementing Superfund. The environmentalist group said that the funds budgeted for cleanup are as much as 50% less than what EPA calculated were necessary in 1980, when Superfund legislation was being drafted. Obligated funds for cleanup are 37% below those targeted in 1980. And funds actually spent on cleanup, though unknown, are estimated by the group to be "a small fraction of the funds obligated."

More pointedly, the Sierra Club charges the Reagan Administration with balancing the budget, in part, on the back of Superfund. By the end of fiscal 1983, the Superfund kitty—fees collected on oil and chemical feedstocks—will be a fat $370 million, the group estimates. By not using these funds to clean up abandoned waste dumps and by treating the funds as regular government income, the Administration is using them to offset the federal deficit, the group contends.

Sensing that the report was political fodder, EPA hastily arranged a press conference to spotlight its Superfund achievements and to announce a $7.7 million settlement with 24 major corporations to clean up the Seymour, Ind., hazardous waste dump site. Under the agreement, these private funds will be used to remove 60,000 rusting drums, 98 bulk storage silos, and contaminated soil.

Rita M. Lavelle, assistant EPA administrator for hazardous waste, says the Seymour settlement "is proof that our approach is working." She calls the Sierra Club report "inadequate, irresponsible, and totally inaccurate."

The hazardous waste issue isn't the only environmental matter with political currency. To the surprise of all parties to the clean air debate, President Reagan has decided to push for revisions to the Clean Air Act in the upcoming lame-duck session. Reagan, his aides say, believes that changes to auto emission standards and to some stationary-source standards could bolster the ailing auto and steel industries. And some contend that the Interior Department is not announcing major changes such as the development of wilderness areas in the Southwest until after Nov. 2, to prevent electoral losses in New Mexico and Arizona. □

The 14-acre dump site in Seymour, Ind. is leaking toxic and flammable chemicals

Chicago plans to woo high-tech industries

With many of its traditional industries in a state of decline, Chicago finally has decided to jump on the already crowded high-technology bandwagon. Four high-technology fields have been targeted as being especially suitable for development in the Chicago area: electronics, communications, and computer technology; manufacturing automation, including robotics; biotechnology; and energy management and control systems.

These targets are embodied in the final report of Mayor Jane M. Byrne's "Task Force on High Technology Development," just issued after a year's deliberations. The task force, comprising some 40 local business, labor, education, and government leaders, is headed by Walter E. Massey, director of Argonne National Laboratory. Task force members note that the Chicago area "possesses tremendous scientific and technical resources for high-tech-

Specialty adhesives business holding up well

Commodity adhesives are suffering from economic downturn, but producers of specialty products report record third quarter

Patricia L. Layman
C&EN, New York

For commodity adhesives, this has not been a good year. But for specialty, formulated products, the past year has been good, and the near-term outlook is promising. In fact, one industry observer goes so far as to say that the adhesive industry has held up well under the general downturn of the past nine months. Where the coatings industry will be down probably 10% from the levels of 1981, the adhesives industry will be up a little. Not a lot, of course, but a gain of 2 to 3% given the depressed economy is no small matter.

And for some companies, this year will turn out to be even better than that small increase in business. At a recent raw materials seminar of the Adhesive & Sealant Council, for example, several manufacturers reported that the third quarter of this year, in particular, would be their best ever. Not all producers reported results that good, but for those few who were singing the blues, far more were predicting that 1982 would be a good year for them.

The key seems to be "specialty." Even in a specialties world such as adhesives, producers who carve out special areas with tailored products wind up doing better than producers whose materials would be classified more as commodities. And one can roughly define the field of specialty adhesives to open a lot of room for product differentiation. According to consultants at Chemical Marketing Services, Cincinnati, the total demand for film-forming resins—excluding natural products such as starches and dextrin, and high-volume commodity adhesives such as urea-formaldehyde used pretty much as is—will be nearly 2.5 billion lb this year. By the time these resins are compounded into finished adhesive formulations, the volume rises to about 3.3 billion lb.

That 2.5 billion lb of adhesives is about the same size as the total demand for film-forming resins in the industrial-coatings business. However, with coatings limited to a growth rate not much better than that of the gross national product, roughly 2 to 3% per year, use of synthetic adhesives is growing at better than twice that clip. And there are a number of the synthetic resins which, as a group, are growing at more than three times the overall adhesives-industry rate.

Chief among them are acrylics, anaerobics, cyanoacrylates, epoxies, polyamides, polyesters, polyethylenes, silicones, urethanes, and vinyl acetate copolymers. For these resins, the major attraction is the ability to tailor or modify the resins for special applications, particularly by forming selected copolymers, and the increasingly important ability to be compounded into water-borne systems.

Air-pollution regulations have forced adhesives makers and users to give more and more attention to nonsolvent systems. Rising energy costs and raw material costs have added to the impetus. Complicated solvent-recovery systems and incineration units are costly and often unwieldy, so users are getting help from suppliers of emulsion and dispersion formulations, 100%-solids hot-melt compounds, to some extent compounds that cure upon exposure to ultraviolet or electron beam radiation, and products that, if not solvent-free, are at least lower in solvents and higher in solids than before.

That much was clear from the Adhesive & Sealant Council's meeting in Chicago earlier this month. Of the nine products introduced at the seminar, four were aimed at the aqueous-formulation adhesive maker. Others were specialty modifiers—thickeners, for example, or solvent extenders—and block copolymer solids systems.

For example, raw-materials suppliers played on the virtues of vinyl acetate as an adhesive: ability to adhere to many surfaces, controlled amount of tack or stickiness, adhesion upon initial contact, and the like. Perhaps because they are components in such everyday items as adhesive mending tape, the labels on the backs of convention tags, and masking tape, pressure-sensitive adhesives tend to be ignored or downplayed. But they make up a respectably sized segment, probably about 15%, of the nearly 3.5 billion lb-per-year market for formulated synthetic adhesives. And they have one of the soundest futures in terms of growth rates in the industry, at probably more than 10% per year through the 1980s.

Thus, there is a considerable attraction for suppliers, particularly of acrylic systems. That's so even though a little adhesive goes a long way, in effect limiting the market for raw-material suppliers. In comparison with other adhesives that might be troweled or sprayed onto a carpet backing or tile backing, for example, at up to 150 sq ft per gal, a pressure-sensitive adhesive will be deposited on its backing substrate at as much as 10 times that coverage per gallon.

Performance modifiers that meet the special requirements of latex systems have become especially im-

Adhesives at a glance

Sales: about $2.2 billion in 1982, for specialty adhesives, at manufacturer's level

Growth: 6 to 8% per year in dollar volume, and 5 to 6% per year in poundage, through the decade

Manufacturers: Diffuse, unstructured industry with probably close to 1000 manufacturers and formulators. The top eight producers—Avery International, Borden Chemical, Du Pont, H. B. Fuller, Loctite, National Starch & Chemical, 3M Co., and USM's Bostik Chemical—account for about 30% of output.

Principal adhesives by type: Synthetic resins 50%, natural resins 40%, sealants and caulks 10%

Principal adhesives by end-use: Paper products 49%, wood products 18%, sealants and caulks 10%, other markets 23%.

portant. Thickeners, for example, must be effective at the certain pH ranges desired; mildewcides must be effective in combating microbial growth that can thrive in aqueous formulations.

Vinyl acetate formulations are getting steady attention from manufacturers, a point that has kept demand fairly constant for this key monomer over the past several years (C&EN, Aug. 2, page 9). Again, the strongest markets for the product are in specialities—especially with copolymers, such as acrylic or ethylene. As one industry marketer notes, the economics of vinyl acetate and its basic adhesive properties make it an ideal base for aqueous formulations. And it is relatively easily tailored for other more specific properties, so, "so much the better," this marketer adds.

Similarly, researchers are trying to work the bugs out of formulations of urethane aqueous systems. Urethane dispersions tend to be high priced; "That's where the dialogue stops and you have to retreat for a while," one marketer says. One prospect, however, is blending the urethane dispersions with other aqueous systems, to improve base performance and absorb some of the cost differential. The blend could go from 20% urethane-80% copolymer to a 50-50 ratio, to get any noticeable contribution from the urethane.

From one specialty resin to another is a short step for adhesive chemists, especially with resins such as acrylics and urethanes. Besides urethanes in aqueous systems, for example, companies are putting substantial emphasis on developing structural urethane adhesives—copolymers with anaerobic adhesives, for example. The urethanes lessen the brittleness and improve the tensile strength of the anaerobics; some marketers of anaerobics, in fact, contend that they have anaerobic formulations whose properties equal those of epoxy adhesives for structural bonding.

That's not saying that, with all the fuss about aqueous and other nonsolvent systems, no attention is being given to solvent-borne formulations, which are still, by and large, the mainstay of the adhesive industry. However, most of the R&D work features ways to formulate away from the aromatic solvents, and lessen the total solvent concentration, to raise the concentration of solids.

And sometimes the work can involve some sophisticated chemistry. Take, for example, Shell Development Co.'s "spaghetti and meatballs" theory on formulating clear sealants out of block copolymer rubbers. Such sealants are normally opaque, Shell researchers agree, because the materials added—other resins, oils, plasticizers, and the like—are of differing refractive indices from those of the polystyrene and the elastomer (for example, polyisoprene, polybutadiene, or polyethylenebutylene) in the block copolymer.

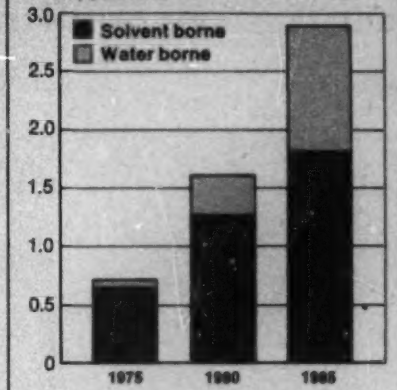
As Shell chemists see it, polystyrene is on either side of an elastomer midsegment, in a long strand. The strands of the copolymer cluster around rather like strands of spaghetti, with the polystyrene ends clustering together in domains—the meatballs of the theory.

The domains are spherical, notes Geoffrey Holden, a Shell researcher in block copolymers, with an effective diameter of less than the 200 Å for typical polystyrene segment molecular weights. Additives compatible with the polystyrene phase in the thermoplastic copolymer are absorbed into the polystyrene domain, without scattering light. Similarly, additives compatible with the elastomer midsegment disperse in that phase with no light scattering. Materials incompatible with both the polystyrene and elastomer, or compatible with both, tend to form a separate phase, agglomerating together, picking up and scattering light, with the result an undesirably opaque product.

Styrenic block copolymers are one of the basic resin families important for hot-melt adhesives, 100%-solids systems melted for application, which seal or bond as they cool. However, ethylene-vinyl acetate copolymers make up more than half of all hot melts, estimates supplier U.S. Industrial Chemicals. U.S.I. predicts that this segment of the business will account for about 400 million lb by 1985, up from 310 million lb in 1980.

Hot-melt adhesive emerges from extruder at Borden Chemical's Louisville plant

Latex products taking over pressure-sensitive adhesives



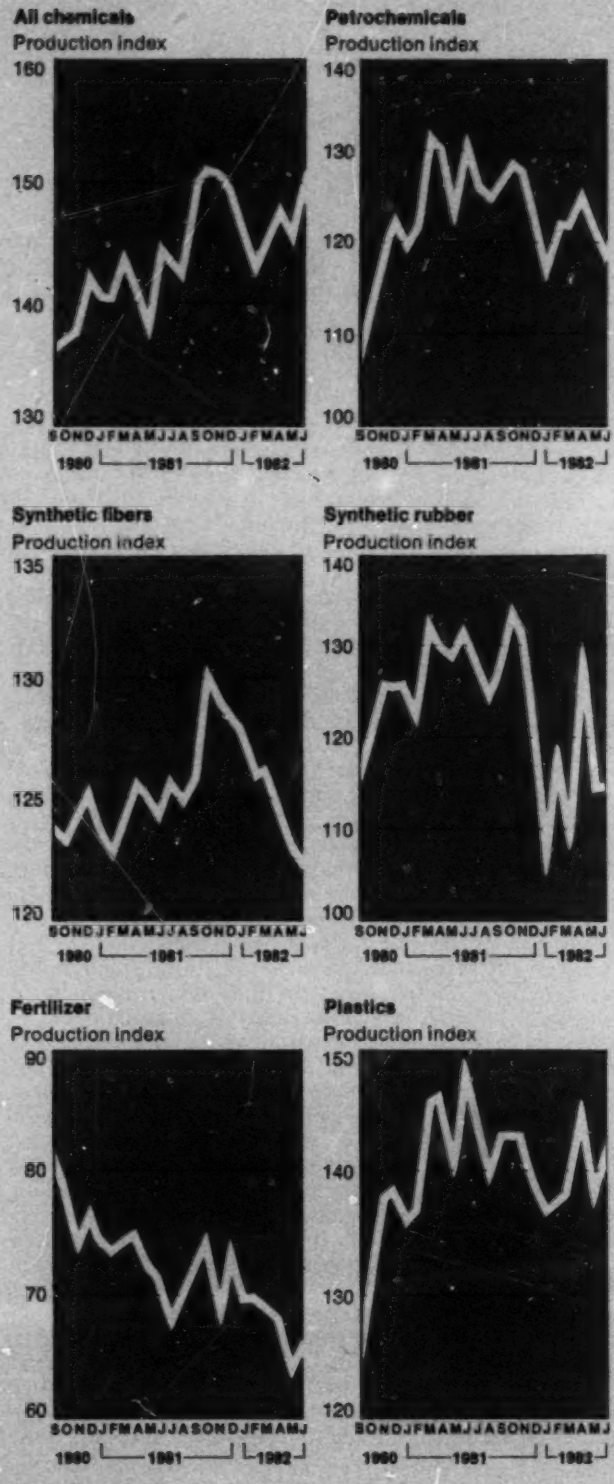
Sources: Hardman, C&EN estimates

Packaging was the largest consumer of hot melts, accounting for some 53% of the total in 1980, but U.S.I. predicts that this will fall to about 47% by 1985. Packaging applications are maturing, the company says, and nonpackaging applications, such as automotive, textiles, electrical equipment, disposables, and furniture, will be growing at a much faster rate over the next few years.

That's important for adhesives makers who want to keep their markets growing. Given the economy, it's probably easier said than done to find new growth areas, but developments in other product businesses help. In the auto industry, for example, an industry not particularly thriving at present, increasing use of plastics has set up increasing demand for adhesives—plastics can't be riveted or welded as metal can. And the booming popularity of plastic beverage bottles has opened a new market for labeling adhesives that have the ability to stick to plastics.

Opening up of these growth areas will help U.S. consumption of adhesives and sealants exceed 15 billion lb in 1995, says Predicasts, a consulting firm in Cleveland. In fact, the company adds, substitution of adhesives for other fastening techniques, and the higher cost of the specialty synthetic adhesives will gain a 55% share of total fastener dollars by 1995, up from 31% in 1979. □

Japanese chemicals continue to be depressed



Note: Base year for all indexes, which are seasonally adjusted, is 1975 = 100.
Source: Ministry of International Trade & Industry

The basic weakness and vulnerability of Japan's petrochemical industry continues to be painfully apparent.

At the end of June, the production indexes for petrochemicals, synthetic fibers, synthetic rubber, plastics, and fertilizer were lower than they were the year before. And in June 1981, all of these indexes were lower than the year before that.

The problems are well documented: depressed markets at home and abroad, high feedstock prices that put the industry at a competitive disadvantage against foreign companies, declining exports and increasing imports, excess capacity, and little or no profits.

Overcoming these problems won't be easy. Rationalization or antirecession cartels are the primary tools that Japan intends to use to solve the structural problems of its petrochemical industry and other ailing basic industries, such as aluminum, textiles, and pulp and paper.

Recently, Japan's Fair Trade Commission authorized an antirecession cartel for 12 ethylene producers. The cartel will operate for a 5.5-month period, from Oct. 16, 1982, to March 31, 1983. During that time, the cartel, the first for ethylene in Japan in 10 years, will limit output to 1.55 million metric tons—3.6% less than during the corresponding period of 1981–82. More significantly, that output level is only 56% of Japan's rated ethylene capacity, which is less than the operating rate that producers have been averaging so far this year.

Very few doubt that some mechanism is needed to pare excess ethylene capacity. However, some experts already doubt that the 12 producers who previously fought tooth and nail for market share will be able to make the cartel work. One reason for these doubts is Japan's August ethylene production, which hit 330,000 metric tons—the highest monthly output this year and only the second time output has reached that level since June 1980. Certainly, the market didn't require that much ethylene. Production was down more than 4% during the first half of the year and averaged less than 300,000 metric tons per month over that time span.

The prevailing explanation is that producers, anticipating that an antirecession cartel was likely if not inevitable, boosted output in a last competitive stab at market share.

Meanwhile, the petrochemical industry's problems extend beyond ethylene. The Chemical Industry Committee of the Industrial Structure Council estimates that by 1985, overcapacity within the petrochemical industry will range from 20 to 35%. Typical of the results are overcapacity of 21 to 30% for polyethylene (depending upon type), 35% for acrylonitrile, and 26% for polyvinyl chloride.

The Chemical Industry Committee's estimates are based upon its own projections of petrochemical imports. But the Ministry of International Trade & Industry thinks that those projections might be low. Thus, future overcapacity might be higher than expected.

MITI could be right. During the first half of the year, Japan's petrochemical imports topped exports for the first first-half deficit (volume basis) in the history of its petrochemical industry.

Earl Anderson, New York

Handling of rail chemical spill praised

Thanks to safety devices, insulation, and preparedness by authorities, recent train derailment of chemical tank cars caused no injury, death

Rebecca L. Rawls
C&EN, Washington

Although the public at large may view things differently, the rail and chemical industries are quietly proud of what happened in Livingston, La., in the last days of September and the beginning of October.

It would have been better, of course, if the 101-car Illinois Central Gulf freight train had not derailed in the predawn hours on Sept. 28, strewing 43 of its cars along the main road of that rural Louisiana town some 30 miles east of Baton Rouge and forcing 3200 people to evacuate their homes, some for as long as two weeks.

But, as the industry is quick to point out, train derailments involving hazardous materials are very rare—99.99% of rail shipments of hazardous materials are delivered without incident, which is one of the best records in transportation. And the record is getting better. The number of releases of hazardous materials from rail cars has fallen by some 40% since 1978 to just over 200 in 1981. Injuries from such incidents have dropped more than 50% over the same period.

"We can never totally prevent all accidents," says Geraldine V. Cox, vice president and technical director of the Chemical Manufacturers Association, and her words echo the feelings of almost everyone involved in hazardous materials transport. "Our job is to minimize the number of accidents and to give as large a margin of safety as is possible each time an accident occurs," she says.

It is in this area of safety margins that the industry feels proud about the Livingston derailment. Safety devices retrofitted onto the cars of the derailed train worked as they were designed to do. Thermal insulation, designed to keep tank cars from exploding for several hours in even the most dramatic accident, lasted not just for hours, but for days. True, two cars did explode—or thermally rupture as the jargon of the trade calls it—but not before area residents had been evacuated and police and firefighters had had a chance to get ready for such an explosion.

Two aspects of the Livingston incident in particular are drawing praise from industry observers. These are the effectiveness of safety devices now required on tank cars that carry hazardous materials, and the preparedness of Louisiana authorities who took charge of the accident. "I've been to too many derailments," says Thomas Phemister, head of the Association of American Railroads' bureau of explosives, "and this one was the best coordinated that I've ever been to."

"Frankly, I was impressed with the way the incident was handled," says John C. Zercher, director of the Chemical Transportation Emergency Center (CHEMTREC) run by CMA. "Unquestionably, this was the worst derailment I've been involved with, both in terms of the amount of hazardous material involved and the mix of different kinds of materials that presented different hazards," Zercher says. "It was one big social disruption—nobody could question that—but there were no injuries except for one man who was bitten while feeding a dog."

Although railroad investigators and those from the National Transportation Safety Board still are working to piece together all the details of what caused the derailment at Livingston, much of the picture is clear. The train was on a return run from Baton Rouge to McComb, Miss., traveling on straight, level track. Seventeen of its cars were empty, and the rest contained quite a list of potentially hazardous materials: seven cars of vinyl chloride and one of methyl chloride, a close chemical relative; one car each of metallic sodium, styrene, and tetraethyllead; three cars of toluene diisocyanate; 11 of phosphoric acid; and one of sodium hydroxide.

According to the railroad, the derailment was caused by a complete break in the center pin that held the wheel assembly onto an empty, open-topped gondola car. The break was an old one—it already was rusty—but located in a spot that would not be noticed except in an inspection of internal body parts. Because the pin was broken, the wheels were able to work out from under the body of the car.

Further investigation unearthed

UPI photo

Illinois Gulf Central freight train accident, which resulted in the spilling of hazardous chemicals, was caused by a break in the pin that holds the wheels on

several irregularities surrounding the run. The train probably was speeding, traveling at about 40 mph in a zone with a speed limit of 25 mph. The engineer and brakeman were seen drinking earlier in the evening, although whether they actually were intoxicated at the time of the derailment is not known. In any case, the train probably was being driven not by the engineer, but by a clerical worker with the railroad who was not even authorized to be in the engine's cab. Louisiana state police arrested the clerical worker, along with the engineer and the brakeman. They are charged with reckless handling of hazardous materials, a felony offense that carries a sentence of a $5000 to $10,000 fine or five to 10 years imprisonment, with or without hard labor, or both.

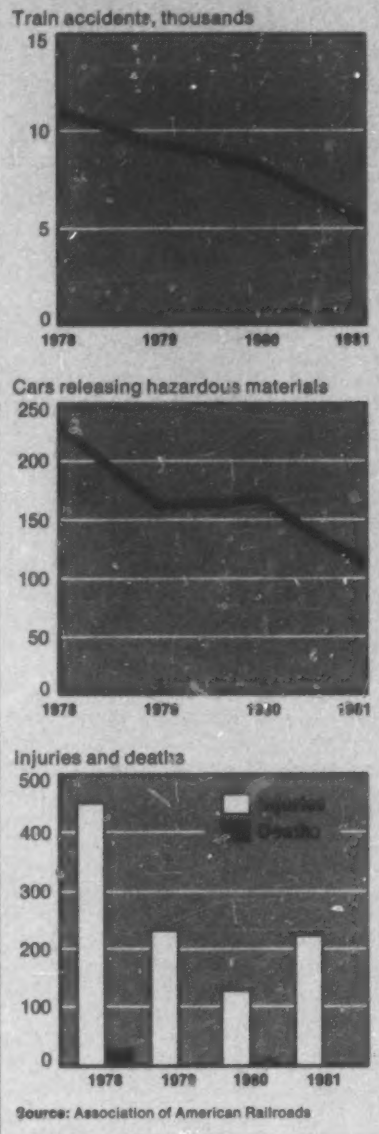
It's quite likely that neither the drinking nor the clerical worker's possible operation of the train had any effect on the derailment. The crew "did exactly what they were supposed to do when the emergency occurred," according to a police spokesman, and they didn't give people they dealt with the impression they were intoxicated.

In fact, once the train left the tracks, no one seems to have anything but praise for the behavior of everyone involved in the incident. "I've never seen an incident where everyone cooperated so thoroughly," says AAR's Phemister, who arrived on the scene on the day of the derailment to provide expert assistance and stayed on for the first two weeks of the cleanup. "The big difference here was that the police officers [who were in charge of the operation] had had hazardous materials training. They knew what was being talked about by the chemicals and hazards specialists, so they could participate fully in all of these discussions," Phemister says.

Another key factor, according to Cox and other observers, is that the police were able to take charge quickly of the overall emergency response effort. "In some states, a lot of time is lost at the very beginning of an incident fighting over who's in charge," Cox says. Louisiana state law gives this responsibility to the state police, who, under the direction of Capt. Billy Poe, responded rapidly and appropriately.

The police were well prepared to take charge. Only a month earlier they had taken part in a hazardous materials drill in New Orleans. Last summer some of the police force attended a hazardous materials training session at the Denver (Colo.) Fire School, and last April they were part of a conference in Milwaukee on coping with railroad hazardous materials spills. The conference was sponsored by AAR, CMA, the Environmental Protection Agency, and the Coast Guard.

Rail incidents involving hazardous materials fell



Source: Association of American Railroads

The team headed by Poe included, in addition to state police and local firefighters, representatives of the Illinois Central Gulf railroad, Phemister and others from AAR's bureau of explosives, Coast Guard and EPA representatives, and representatives of the chemical companies whose shipments were on the train.

The railroad hired an environmental monitoring firm, IT Corp., to keep track of chemical concentrations at the site and to advise emergency personnel on the sort of protection they would need to do their work. The company also monitored for the spread of environmental contaminants from the accident site.

Twice a day helicopters flew over the site photographing the exact positions of the train cars. Strategy for cleaning up the site involved mostly pulling undamaged cars away from the accident site and letting the remaining cars burn to minimize the environmental consequences of their leaking contents. In several cases, cars were ruptured deliberately and their contents burned in a controlled manner since this was the surest way to keep their contents from contaminating the local area. The phosphoric acid was neutralized with a base and the reacted material hauled away.

Another important factor at Livingston was the recently implemented changes in the specifications for tank cars that carry hazardous materials. These changes arose from a series of recommendations made by a 1978 interindustry working group on rail transport of hazardous materials.

The changes demonstrated their value at Livingston, says CMA's Cox, who served on the 1978 task force and presently is on the task force that succeeded it. Besides CMA, the task force has members representing AAR and the Railway Progress Institute, an association of tank car owners.

Among the recommendations of this task force was a new kind of connection between cars called shelf couplers. The ordinary coupling between train cars resembles two hands joined together by curled fingers. In a shelf coupler, the thumbs of each hand rest on the little finger of the opposite hand. The effect is to prevent a vertical motion from uncoupling the cars. Once uncoupled, couplers act like battering rams to punch holes in the ends of adjacent tank cars, so keeping them from breaking free is an important safety improvement.

Another recommendation that addressed the same problem called for tank cars to be fitted with head shields, which are half-inch steel plates that fit to the lower half of the ends (or heads) of tank cars, to make it much more difficult for couplings to punch through the ends of the cars. Cox says there were no head punctures in the Livingston

derailment, evidence that these two devices did their job.

Cars carrying flammable materials also have been retrofitted with extra insulation designed to delay their blowing up long enough for emergency workers to prepare for it. All of the cars containing flammable gases on the Livingston train had this extra insulation. Although two cars did thermally rupture, the first one (containing tetraethyllead) did not blow up with the tremendous explosive power that can accompany such an occurrence, and the second (containing vinyl chloride) did not explode until two days after the fire started. "In the same situation 10 years ago [before the cars were retrofitted]," Zercher says, "the seven cars that contained vinyl chloride almost certainly would have gone up in the first four and a half hours of the [fire's duration]." As it was, only one of these cars blew up at all and that was well after people had been evacuated from the area.

Other recommendations of the 1978 task force included development of large-scale training programs for emergency response personnel, such as those in which the Louisiana police participated, and development of a permanent teleconferencing "bridge" at CHEMTREC. This system allows on-site personnel to be in simultaneous communication with experts at several chemical companies who can advise them on particular hazards; it was used several times during the emergency.

Although the firefighters have left and the residents of Livingston have returned to their homes, the Livingston derailment is by no means over. Environmental monitoring of the area continues, for example. Reports so far indicate no adverse residual levels of phosphoric acid, one of the most important potential environmental hazards. And the lead levels in Livingston, which might have been elevated due to the explosion of the car containing tetraethyllead, are lower than control readings in an adjacent county.

The railroad is continuing its investigation of the incident, focusing particularly on the conduct of its employees. The National Transportation Safety Board, too, is continuing its investigation of the causes of the incident. And the state of Louisiana continues to develop its case against the people who have been arrested.

The question of whether alcohol was a contributing factor to the derailment is one of particular concern to the safety board. There currently are no federal regulations forbidding railway personnel from drinking while on the job or from driving a train while intoxicated—a situation that the safety board has been on record as wanting to change since 1974. "The record of alcohol misuse in the railroads is incredible," says Ira Furman, a spokesman for the board. He cites, among other data, a 1978 study conducted for the Federal Railroad Administration that found an average of 33 railway workers every day who considered themselves to be "very drunk" on the job. About 12% of the 234,000 railroad workers surveyed said they drank at least once while on duty in 1978.

C&EN staff photo

Zercher: one big social disruption

Another issue that may have affected the Livingston incident that the safety board is concerned about is the arrangement of full and empty cars on a train. At present, the cars on a train are arranged according to the order in which they will be dropped off at their destination. Thus, it is quite likely that cars containing the same hazardous material will be scattered throughout a train with no regard to the contents of adjacent cars. (The only exception is a requirement that cars that contain railroad personnel be separated from those containing hazardous materials by at least five cars.)

None of the concerned parties—the chemical shippers, the railroads, and the safety board—is seriously considering trying to group chemical tank cars by their content on freight trains; the rearrangements that procedure would entail at each transfer point would be too formidable. But the safety board is concerned about the differences between full cars and empty ones in a derailment. It is investigating the effect of a car's weight on its crash dynamics to see if trains might be safer if the empty cars were grouped together and arranged so that loaded cars would not crash into them.

The interindustry task force that recommended many of the tank car changes that were so useful at Livingston presently is in a "second incarnation" as Cox calls it. The group was reformed last summer to suggest further improvements in the safe transportation of hazardous materials and the handling of spills.

Although its report is not expected for several months, Cox says the task force this time is not really focusing on major derailments like the one at Livingston. Rather, it is directing its attention to the small spills that account for almost all of the incidents that occur. Although major derailments attract the most public attention, Cox says, most spills are much smaller and involve only the breakage of a bottle or two or a single leaky container. The task force is looking specifically at areas such as the loading process, inspection procedures, and the small-scale releases that sometimes occur at safety valves. It also is considering whether the rail and chemical industries need to improve their public image when major incidents do occur, perhaps by having a public relations person at the scene. □

New system eliminates spectral interferences

A just-introduced atomic absorption spectrometer, Instrumentation Laboratory's Video 22, employs a new background correction system that, the company says, offers significant advantages over deuterium-arc and Zeeman-effect systems.

In the new approach, the AA instrument's hollow cathode lamp serves as its own background corrector. As chemists have known for a long time, when a high current is passed through a hollow cathode lamp, its emission line is broadened and atomic absorbance by the sample is reduced greatly. The phenomenon, called self-reversal, generally is regarded as something to be avoided.

However, it occurred to Stanley B. Smith, director of R&D for IL's analytical instrument division, and Gary M. Hieftje, a chemistry professor at